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FLORAL UV PATTERNS AND ANTHOCHLOR PIGMENTS IN THE GENUS *COREOPSIS* (ASTERACEAE)

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INTRODUCTION

The genus *Coreopsis* (Asteraceae, tribe Heliantheae, subtribe Coreopsidinae) has been a traditional source of anthochlor pigments (chalcones and aurones) for their characterization and study (Geissman, 1941). It was long thought (now disproven) that the presence of anthochlor pigments was a definitive phytochemical character of the subtribe Coreopsidinae. Only recently has it been observed (Brehm and Krell, 1975; Scogin, unpublished) that anthochlor pigments are frequently spatially segregated within flowers or inflorescences (as in the Asteraceae) and that the segregation pattern of anthochlor pigments is exactly congruent with the floral UV-absorption pattern visible to pollinating insects. This paper reports the results of a survey of the anthochlor segregation patterns (and hence, UV-absorption patterns) in inflorescences among selected North American species in all sections of the genus *Coreopsis.*

MATERIALS AND METHODS

Plant materials used in this survey were fresh flowers from plants cultivated at the Rancho Santa Ana Botanic Garden or dried materials housed in the herbarium of that institution, the San Diego County Museum of Natural History, or the Los Angeles County Museum of Natural History.

Samples (flower heads or individual ligules) were placed for several minutes in a small closed container in an atmosphere saturated with concentrated ammonium hydroxide vapor and any color change and its extent in the plant materials were noted.

RESULTS

The presence of anthochlor pigments in a flower petal can be detected by a rapid and characteristic color change from yellow to dark orange-red in the presence of a strong base. A survey of selected species of the genus *Coreopsis* revealed three distinct modes of spatial distribution of anthochlor pigments in the ray florets (ligules) among the species examined: (1) the pigment was uniformly distributed the entire length of the ligule (yielding

TABLE 1. *The occurrence of anthochlor distribution modes among sections of the genus* Coreopsis. (*See text for explanation of symbols.*)

SECTION	SECTION
Electra (1/3)	*Coreopsis* (7/12)
Coreopsis mutica DC. (+)(1/3)	*C. lanceolata* L. (–)
Anathysana (2/2)	*C. pubescens* Ell. (–)
C. insularis (Brand.) Blake (+)(1/2)	*C. grandiflora* Hogg. (–)
C. cyclocarpa Blake (+)(1/2)	*C. auriculata* L. (–)
Tuckermania (2/2)	*C. basilis* (Dietr.) Blake (–)
**C. maritima* (Nutt.) Hook. (+)(2/3)	*C. nuecensis* A. Heller (–)
* *C. gigantea* (Kellogg) H.M. Hall (+)(1/2)	*C. intermedia* Sherff (–)
Pugiopappus (3/3)	*Palmatea* (5/6)
C. bigelovii (A. Gray) H.M. Hall (+)(1/2)	*C. palmata* Nutt. (–)
C. hamiltonii (Elmer) Sharsmith (–)	*C. verticellata* L. (–)
C. calliopsidea (DC.) A. Gray (–)	*C. delphinifolia* Lam. (+)(1/2)
Euleptosyne (3/3)	*C. major* Walt. (–)
C. douglasii (DC.) H.M. Hall (–)	*C. tripteris* L. (0)
C. californica (Nutt.) Sharsmith (–)	*Calliopsis* (3/3)
C. stillmanii (A. Gray) Blake (–)	*C. paludosa* M.E. Jones (–)
Pseudo-Agrista (2/6)	*C. tinctoria* Nutt. (–)
C. rhyacophila Greenm. (+)(1/3)	* *C. leavenworthii* T. & G. (–)
C. petrophiloides Rob. & Greenm. (+)(1/2)	*Eublepharis* (5/9)
	C. gladiata Walt. (–)
	C. helianthoides Beadle (–)
	C. nudata Nutt. (–)
	C. linifolia Nutt. (–)
	C. falcata F. Boyton (–)

* Those species in which the congruence of anthochlor distribution and UV reflection-absorption patterns has been experimentally confirmed.

a completely UV-absorptive ligule), denoted (–) in Table 1; (2) the pigment was restricted to some basal fraction (indicated in parenthesis) of the ligule (yielding a basal UV-absorption, apical UV-reflection pattern in the ligule) and denoted (+)(x/y) in Table 1; and (3) the pigment was generally absent from the ligule, occurring only in the veins (yielding a totally reflective UV pattern) denoted (0) in Table 1. Species are listed by sections according to Smith (1975). The fraction of all species examined in this survey within each section is given in parenthesis.

DISCUSSION

The mode of spatial segregation of anthochlor pigments (and hence, UV-absorption patterns) falls generally along recognized taxonomic (sectional) lines. These results support the suggestion that floral UV-absorption patterns are a valuable taxonomic character (Eisner et al., 1973). The few exceptions to the above generalization (e.g., *C. delphinifolia, C. bigelovii* and *C. tripteris*) may serve to identify taxa whose taxonomic positioning may warrant reevaluation. Alternatively, these taxa may possess some unique feature in their pollination biology which should be identified.

The presence of an absorption-reflection pattern appears to be a primitive character in the genus *Coreopsis*, with the totally absorptive ligule being a derived, advanced character. A comparison of the occurrence of anthochlor pigment modes among sections with the arrangement of those sections in terms of evolutionary advancement (based on 17 morphological characters) (Smith, 1975) shows that reflection-absorption patterns occur only in Smith's most primitive sections. Reflection is lost (ligules are totally absorptive) in the advanced sections of three independent evolutionary lines. These observations suggest that Smith's putative ancestral *Coreopsis* had a floral UV-absorption-reflection pattern and that this pattern has been lost independently in three evolutionary lines.

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